Remarks

In the non-final Office Action mailed on August 9, 2006, the Examiner rejected claims 1-4, 8-12 and 16-19 under 35 U.S.C. 103(a) as unpatentable over U.S. Patent 5,974,502 (DeKoning) in view of U.S. Patent 6,877,045 (Goode), U.S. Patent 6,301,625 (McDonald) and the Applicants' admitted prior art (AAPA). The Examiner rejected claims 5-7, 13-15 and 20-22 under 35 U.S.C. 103(a) as unpatentable over DeKoning, Goode, McDonald and the AAPA in further view of In re Japiske, 181 F.2d 1019, 86 USPQ 70 (CCPA 1950); In re Kuhle, 526 F.2d 553, 118 USPQ 7 (CCPA 1975). The Examiner objected to Figures 1, 3 and 4 of the drawings. Specifically, the Examiner stated that Figures 1, 3 and 4 should be designated as prior art, because only that which is old is illustrated.

Applicants respectfully traverse the Examiner's objections and rejections, and request reconsideration and withdrawal of same. Applicants have amended claims 1 and 16 to clarify that the *M* PHYs available for use to process the I/O request are a portion of the *n* PHYs associated with the SAS wide port. Applicants have further amended claims 1, 8, 9, 11, 12 and 16 to clarify that the I/O request corresponds to an original SAS frame, and the original SAS frame is divided into a plurality of smaller SAS frames. As described in the specification, I/O request and frame are essentially used interchangeably. Those of ordinary skill in the art will recognize that an I/O request within a SAS domain is transferred as a SAS frame between components of the SAS domain.

Objection To The Drawings

The Examiner objected to Figures 1, 3 and 4 of the drawings. Specifically, the Examiner stated that Figures 1, 3 and 4 should be designated by a legend such as prior art, because only that which is old is illustrated. Applicants respectfully traverse the Examiner's objection to the drawings, as Figures 1, 3 and 4 illustrate exemplary aspects of the invention, and thus illustrate more than the prior art.

Specifically, Figure 1 illustrates a system embodying features and aspects hereof to improve utilization of a SAS wide port in a SAS domain (specification, page 6, lines 11-18). The exemplified SAS domain 100 comprises an enhanced SAS initiator 102 enhanced by the addition of wide port distribution logic 103 providing features and

aspects hereof operable within the SAS initiator (specification, page 6, lines 19-21). Such features allow a single SAS frame to be transferred through multiple PHYs, and are not found in the prior art. Figure 3 shows a system 300 comprising an enhanced SAS driver 332 implementing similar functionality as enhanced SAS initiator 102 (specification, page 8, lines 15-20). Figure 4, shows a system 400 comprising enhanced SAS expander set 404 implementing similar functionality as enhanced SAS initiator 102 (specification, page 10, lines 1-8).

For the reasons stated above, Applicants submit that Figures 1, 3 and 4 illustrate components which are not found in the prior art. Specifically, Figures 1, 3 and 4 illustrate enhanced SAS initiators, enhanced SAS expander sets and enhanced SAS drivers that allow a single SAS frame to be transferred through multiple PHYs of a wide port. Applicants respectfully request reconsideration and withdrawal of the objection to the drawings.

35 U.S.C. §103 Rejections

The Examiner rejected claims 1-4, 8-12 and 16-19 under 35 U.S.C. 103(a) as unpatentable over DeKoning in view of Goode, McDonald and the AAPA. The Examiner rejected claims 5-7, 13-15 and 20-22 under 35 U.S.C. 103(a) as unpatentable over DeKoning, Goode, McDonald and the AAPA in further view of In re Japiske, 181 F.2d 1019, 86 USPQ 70 (CCPA 1950); In re Kuhle, 526 F.2d 553, 118 USPQ 7 (CCPA 1975). The rejections will be discussed in regard to independent claim 1.

Claim 1 is directed at a method for improving utilization of a SAS wide port. The SAS wide port has a number *(n)* associated PHYs. The method comprises receiving an I/O request (corresponding to an original SAS frame) from a requesting host. The I/O request comprises a large block (having a size of *S* units of data) intended for transmission as a single transaction. The method further comprises determining if the size of the original SAS frame data *(S)* is greater than a threshold size *(T)*.

If $S > T$ (e.g., the size of the original SAS frame data is greater than the threshold size), then the method further comprises determining a number *(M)* of the *n* PHYs comprising the wide port available for use to process the original SAS frame. The original SAS frame is then subdivided into *M* smaller SAS frames of substantially equal

size. The *M* smaller SAS frames are then processed substantially in parallel using the *M* available PHYs. Thus, each one of the *M* available PHYs transfers one of the *M* smaller SAS frames. The method further comprises returning a single status to the requesting host system indicating the status of processing of the *M* smaller SAS frames. The method of claim 1 thus allows for an I/O request involving a large block of data (i.e., a large frame) intended for transmission as a single transaction to be subdivided into several smaller transactions (i.e., several smaller SAS frames) transferred in parallel using a plurality of PHYs.

Nothing in the prior art of record, considered individually, or in any combination, teaches the method of claim 1. The Examiner states that DeKoning teaches subdividing the I/O request into smaller requests of substantially equal size and processing the smaller requests substantially in parallel. Applicants respectfully disagree. DeKoning does not teach subdividing a plurality of I/O requests into smaller requests of substantially equal size and processing the smaller requests substantially in parallel. Rather, DeKoning operates by splitting up large I/O requests from the host computer into smaller, more manageable pieces and processes the pieces as though they were individual I/O requests in a current order (abstract of Dekoning). Only a limited number of these smaller individual I/O requests may be kept "active" within the controller at any particular time so that a single large I/O request cannot preclude other I/O requests from making progress in the controller (abstract of Dekoning). Thus, the system of Dekoning operates to split up a large request into smaller more manageable pieces by the controller. These smaller requests are not split up for transmission in parallel across multiple physical pathways (e.g., PHYs) between a host system and an attached device. Further, these smaller requests are not even split up for execution in parallel. Nothing in DeKoning suggests splitting up a single frame for transmission or processing in parallel using multiple physical pathways of a SAS wide port (e.g., multiple PHYs of the wide port). DeKoning does not even teach or reasonably suggest use of a SAS wide port (e.g., multiple pathways between two devices).

The Examiner states that it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the SAS protocol with the command division of DeKoning in order to exploit the advantages of parallel processing. The

Examiner supports this assertion by pointing to the AAPA, which generally discusses SAS protocols. Applicants respectfully traverse the Examiner's assertion that it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the SAS protocol with the command division of DeKoning in order to exploit the advantages of parallel processing. The AAPA characterizes the SAS protocol as lacking the ability to transmit a single large frame across multiple PHYs (e.g., multiple physical pathways between two devices). Thus, SAS domains are unable to fully utilize the transfer bandwidth available in a SAS wide port environment for transferring a single frame. The SAS specifications require selection of a single PHY to further the transaction of a particular I/O request (i.e., a single frame). The method of claim 1 corrects problems in the prior art by allowing full utilization of the enhanced bandwidth of a configured SAS wide port, which is not shown in the prior art of record, considered individually, or in any combination. The AAPA does not teach nor reasonably suggest splitting a large SAS frame into several smaller SAS frames for parallel transmission using multiple PHYs.

The "advantages of parallel processing" are neither taught nor suggested within the art of the proposed combination (or any art of record individually or in any combination). Thus the motivation or suggestion would appear to arise either from improper hindsight engineering applying the teachings of the subject application or from the Examiner's personal understanding of the art. If the Examiner is asserting "official notice" of such information as obvious to one of ordinary skill in the art, Applicants respectfully request that the Examiner supply a reference in support of the assertion as required by MPEP §2144.03. If the Examiner is asserting facts within his/her own personal knowledge as support for his suggestion of obviousness and motivation to combine or modify the art, Applicants respectfully request that the Examiner supply an affidavit attesting to such facts as required by MPEP §2144.03.

Further, DeKoning in view of the AAPA, even if properly combined or combinable which the Applicants do not concede, does not teach or reasonably suggest splitting up a single I/O request (i.e., a single large frame) into several smaller I/O requests (i.e., several smaller SAS frames) for transmission using multiple physical pathways of a SAS wide port (e.g., multiple PHYs of the wide port).

The Examiner states the Goode teaches dividing commands among a number of available data paths for parallel processing (column 7, lines 18-39 of Goode). However, Goode does not alleviate the deficiencies of the DeKoning reference. Goode teaches nothing more than the AAPA, i.e., transferring multiple I/O requests intended as multiple transactions using multiple pathways. The system of Goode operates to divide multiple commands generated and intended as separate commands among multiple pathways. Goode does not teach dividing a single SAS frame into multiple SAS frames and distributing the multiple divided smaller SAS frames among multiple physical pathways of a SAS wide port (e.g., multiple PHYs of the wide port).

The system disclosed by Goode has the same type of problems as the AAPA, which the method of claim 1 solves. Specifically, Goode, like the prior art SAS specifications discussed as AAPA, allows for multiple commands (e.g., frames) to be distributed between two devices through multiple physical pathways (e.g., PHYs). However, both Goode and the SAS specifications fail to disclose, teach, or suggest splitting up a single large command (i.e., a single large SAS frame) intended as a single transaction into multiple commands (i.e., multiple smaller SAS frames), and distributing the multiple commands over multiple pathways (e.g., multiple PHYs of a SAS wide port). Specifically, the SAS specifications require that a single frame be transferred along a single pathway. The method of claim 1, contrary to the teachings of the SAS specifications, allows a single large frame to be broken into multiple smaller SAS frames for transmission using multiple PHYs. The method of claim 1 operates to provide this feature within the workings of the SAS specification. Thus, Applicants submit that neither Goode nor the AAPA teach or suggest using the SAS protocol with the command division of DeKoning in order to exploit the advantages of parallel processing.

Even assuming, *arguendo*, that Goode teaches dividing a single request among multiple available PHYs, i.e., multiple data pathways, Applicants assert that there is no motivation to combine Goode with DeKoning. The Examiner states that it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the command distribution of Goode with the command division of DeKoning in order to exploit the advantages of parallel processing. However, DeKoning does not disclose a parallel processing system where multiple commands or requests are transferred among

multiple data pathways at once. Rather, DeKoning discloses a system where the subdivided smaller requests are processed serially, and not in parallel. Thus, there would be no reason to combine the command distribution of Goode with the command division of DeKoning in order to exploit the advantages of parallel processing, as DeKoning does not disclose or describe uses or advantages of parallel processing.

Further, the Examiner states that McDonald teaches a system for keeping track of individual completion notices of a divided I/O request in order to return a single completion for the original request (column 2, line 41, through column 3, line 46 of McDonald). McDonald describes striping in a RAID system in which multiple blocks of data are written to multiple hard drives in parallel. Once each hard drive successfully completes its intended write request, then an acknowledgment is sent back to the RAID controller. Once all of the drives have completed their intended write request, then the host computer is notified that the write command is complete.

However, the cited passage from McDonald only describes what is already known in the art of RAID controllers, specifically aggregating multiple commands where each are intended as separate commands to determine when a write request is complete. Each of the aggregated multiple commands are always intended as separate commands. While the commands that McDonald tracks are divided in the sense that the controller must write data to multiple hard drives, McDonald does not discuss dividing a single large command (i.e., a command intended for a single hard drive) into several smaller commands for the single hard drive, communicated to the hard drive via multiple pathways, and tracking the progress of the several smaller commands. Thus, Applicants assert that McDonald does not teach "returning a single status of the requesting host system indicating the status of the processing of the *M* smaller requests" as recited by claim 1.

Even assuming, *arguendo*, that McDonald teaches returning a single status to the requesting host system indicating the status of the processing of the *M* smaller requests, Applicants assert that there is no motivation to combine McDonald with DeKoning or the SAS protocol. The Examiner states that it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the command completion of McDonald with the command division of DeKoning in order to exploit the advantages of

parallel processing without creating a bottleneck. However, DeKoning does not disclose a parallel processing system where multiple commands or requests are transferred among multiple data pathways at once. Rather, DeKoning discloses a system where requests are processed serially, and not in parallel. Thus, there would be no reason to combine the command completion notice of McDonald with the command division of DeKoning in order to exploit the advantages of parallel processing, as DeKoning does not disclose or describe uses or advantages of parallel processing. Further, Applicants assert that there would be no reason to combine the teachings of McDonald with the SAS protocol. The SAS protocol does not presently support breaking up a single I/O request into multiple smaller I/O requests, so there would be no reason to track individual completion notices of a divided I/O request in order to return a single completion for the original request.

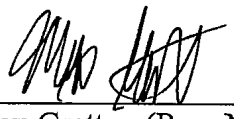
For the reasons stated above, Applicants submit that claim 1 is novel and unobvious over all art of record, considered individually, or in any combination. Applicants respectfully request reconsideration and withdrawal of the rejection of claim 1. These same arguments apply to independent claims 8 and 16, as well as dependent claims 2-7, 9-15 and 17-22. Additionally, dependent claims 2-7, 9-15 and 17-22 recite additional limitations not found in the prior art.

Conclusion

Claims 1, 8, 9, 11, 12 and 16 have been amended to better protect the invention. Applicants have amended the specification to correct several typographical errors. Applicants have thoroughly discussed the objection to the drawings and the rejections of the claims and respectfully request reconsideration and withdrawal of all outstanding rejections and objections.

No additional fees are believed due. Should any issues remain, the Examiner is encouraged to telephone the undersigned attorney.

Respectfully submitted,



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